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CROP SEQUENCE CALCULATOR[z], V.2.1
A REVISED COMPUTER PROGRAM TO ASSIST PRODUCERS

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Abstract

The "Crop Sequence Calculator," designed to help producers assess crop production in a diverse cropping system (Anonymous, 2000; Fehmi et al. 2001; Krupinsky et al., 2001a, 2001b), was revised. The Crop Sequence Calculator (CSC) was expanded to include an additional year of research data, new sections on economics and insects, and a new introduction to the Northern Great Plains Research Laboratory's crop sequence research projects. The 'more information' sections on crop production, plant diseases, weeds, water use, and surface soil properties were improved with additional data, management principles, and internet links. The CSC runs directly from a CD-ROM eliminating the need for additional disk space or installation procedures. Overall, the CSC is a user-friendly tool to help sequence crops when designing diverse cropping systems.

Introduction

The influence of the previous crop and crop residues on crop production, plant diseases, weeds, erosion control, and soil quality need to be more fully understood in order to develop effective crop sequences for diverse cropping systems. A project was established in 1998 to determine the benefits and/or disadvantages of previous crop and crop residues in diverse cropping systems, the first short-term step for the development of long-term cropping systems. A multi-disciplinary team of scientists conducted a research project using no-till management to develop guidelines for long-term diversified crop production systems that provide producers with management flexibility for developing their own cropping systems. After scientists were asked to make research results available in a more timely manner, a computer program was produced to transfer research data. The objective of this paper is not to present research results from the research project itself but rather to describe a computer program that presents research information

and summarizes principles related to management practices that helps producers plan cropping systems.

Materials and Methods

The CSC is based on a research project being conducted at the Agricultural Research Service/Area IV Soil Conservation Districts Research Farm near the Northern Great Plains Research Laboratory, southwest of Mandan, North Dakota, USA. The predominant soil at the site is a Wilton silt loam (fine-silty, mixed superactive frigid Pachic Haplustoll). A crop X crop residue matrix was formed so that ten crops could be seeded into the crop residue of the same ten crops (Figure 1). During the first year, ten crops (barley [*Hordeum vulgare*], canola [*Brassica napus*], crambe [*Crambe abyssinica*], dry bean [*Phaseolus vulgaris*], dry pea [*Pisum sativum*], flax [*Linum usitatissimum*], safflower [*Carthamus tinctorius*], soybean [*Glycine max*], sunflower [*Helianthus annuus*], and wheat [*Triticum aestivum*]) were seeded in strips (30 ft wide) with a no-till drill into a uniform cereal residue. During the second year, the same crops were seeded perpendicular over the residue of the previous year's crop. This established a 10 X 10 matrix with 100 treatment combinations, where each crop was grown on ten crop residues (Figure 1). This was repeated so that the crop X crop residue matrix was present in the field for two consecutive years (1999 and 2000). All crops were seeded in a strip-block design with four replicates. Each experimental unit was a 30 X 30 ft plot. More information on the field operations is included in the CSC.

Various types of research data were obtained from the crop X crop residue matrix. Crop yield and residue production were measured. Concentrations of nitrogen and phosphorus in seed and residue were determined. Root growth of crops was measured. Soil-surface residue coverage was determined. The impact of the ten crops on weed populations was evaluated. Spring wheat and barley crops were evaluated for foliar diseases. Sunflower, canola, crambe, and safflower crops were evaluated for sclerotinia disease (white mold; *Sclerotinia sclerotiorum*). A standard set of soil quality indicators were measured in treatments where the same crop was planted in consecutive years. Crop, weed, plant disease and soil data were used to assess the management impact and predictability of crop production.

Results and Discussion

Research data obtained from a crop X crop residue matrix can be accessed with the CSC. Once the previous crop (residue producing crop) and the expected crop are entered into the CSC with a click of a mouse, summary statements appear regarding crop production, economics, plant diseases, weeds, water use, surface soil properties, and insects. The CSC determines the expected yield of ten crops (barley, canola, crambe, dry bean, dry pea, flax, safflower, soybean, sunflower, and wheat) grown in any two-year combination. Expected crop prices and expected loan deficiency payments and/or crop premiums can be entered to provide rapid calculations of potential gross returns.

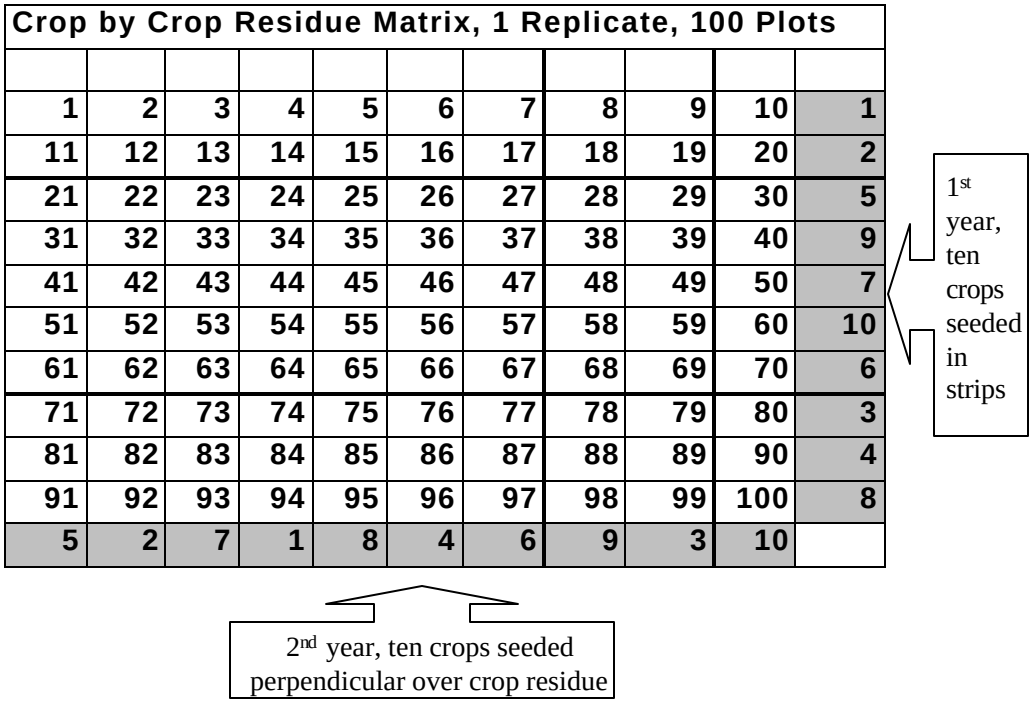

Figure 1. A crop by crop residue matrix used to evaluate the influence of crop sequence on crops. During the first year ten crops (numbered 1 through 10) are seeded into a uniform crop residue. During the second year the same crops are no-till seeded perpendicular over the residue of the previous year's crop. Individual plot numbers are assigned for each replication.

By selecting the "More Info" buttons adjacent to each summary statement, additional information, graphs, photos, and internet resources are easily accessed. In version 2, the crop production/economics section was expanded to include net returns. The disease section contains an introduction to plant disease, new disease data, and photographs of plant diseases to aid in their identification. The soil water section contains expanded information about root length, water use, and crop residue. Principles for managing weeds in cropping systems were added to the weed section in version 2, and weed photographs can be directly accessed. The soil properties section contains new data and management strategies for improving soil quality. The new insect section provides a review of basic insect concepts as well as more specific information on insect pests for individual field crops. The many insect photographs aid in their identification. In this new version, internet resources are easily accessed by clicking on the page, which activates your computers browser providing hot links to numerous internet sites (Anonymous. 2002).

Copies of the Crop Sequence Calculator can be obtained from:
ARS website: www.mandan.ars.usda.gov
or: Crop Sequence Calculator

Northern Great Plains Research Laboratory
Agricultural Research Service-USDA
Box 459, Mandan, North Dakota 58554-0459

Users of the program are encouraged to register their CD-ROM with the Northern Great Plains Research Laboratory. When a new version of the program is produced registered users will receive a copy of a CD-ROM with the new program. No material in this CD may be copied and distributed in part or whole without permission of the research scientists involved.

ACKNOWLEDGEMENT

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LITERATURE CITED

Anonymous. 2001. Crop Sequence Calculator. The Sunflower 27:16.

Anonymous. 2002. Crop Sequence Calculator Updated, Version 2.0 Now Available. The Sunflower 28:18.

Fehmi, J.S., J.M. Krupinsky, D.L. Tanaka, S.D. Merrill, J.R. Hendrickson, R.E. Ries, M.A. Liebig, and J.D. Hanson. 2001. A Crop Sequence Calculator for Designing Dynamic Cropping Systems: Translating Science into Practice. No. 210215-P In: Annual Meeting Abstracts, October 21-25, 2001, Charlotte, NC, ASA-SSSA-CSSA, Madison, WI.

Krupinsky, J.M., D.L. Tanaka, J.S. Fehmi, S.D. Merrill, J.R. Hendrickson, R.E. Ries, M.A. Liebig, S. Wright, and J.D. Hanson. 2001a. A computer program to assist sunflower producers. Pages 83-84 In: Proc. of the 23rd Sunflower Research Workshop, National Sunflower Assoc, Bismarck, ND, 185 pp.

Krupinsky, J.M., D.L. Tanaka, J.S. Fehmi, S.D. Merrill, J.R. Hendrickson, R.E. Ries, M.A. Liebig, S. Wright, and J.D. Hanson. 2001b. A computer program to assist safflower producers. Pages 219-222 In: Proc. of the Fifth International Safflower Conference, July 23-27, Williston, ND, 328 pp.

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